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Lyme disease among U.S. military members, Active and Reserve Component, 2001-2008

Lyme disease is a zoonotic tick-borne disease that is caused by infection with a spirochetal bacterium of the genus *Borrelia*. It has a worldwide distribution and is endemic in many temperate regions of the northern hemisphere. In the United States, it is hyperendemic along the mid- and northeastern Atlantic seaboard and in nonurban areas of Wisconsin.¹⁻⁴

Lyme disease is transmitted by ticks that feed on both humans and animal hosts of *Borrelia* (e.g., deer, mice, raccoons). *Borrelia* are usually transmitted to humans during blood meals of ticks in the nymphal stages of their life cycle. Nymphal stage ticks are very small (approximately the size of poppyseeds); hence, they often feed undetected for the time required to transmit infection (24-48 hours). In the United States, the "deer tick" (*Ixodes scapularis*) and western black-legged tick (*Ixodes pacificus*) are competent vectors of Lyme disease.¹⁻⁴

The clinical manifestations and courses of Lyme disease are highly variable. The time from infection to initial symptoms is generally 7-14 days (range: 3 to >30 days). The presenting manifestation of Lyme disease is often a slowly enlarging, centrally clearing ("bull's-eye") rash at the site of the infecting tick bite (erythema migrans). While erythema migrans is a distinctive characteristic of Lyme disease, it occurs in only 60-80% of cases. Other early manifestations are non-specific and include fever, headache, muscle aches, joint pains, lymphadenopathy, malaise, and fatigue. Without effective antibiotic treatment, acute symptoms can persist for weeks or more. Weeks to months after infection, clinical manifestations of inflammation of the joints, nervous system

(e.g., facial palsy, encephalitis), and heart (e.g., conduction abnormalities) can occur. Most cases are effectively treated with single courses of antibiotics.^{1,4,5}

Many military activities are conducted in tick-infested areas. In such settings, personal protective measures (e.g., use of DEET-containing insect repellents, proper wear of permethrin-treated uniforms, frequent inspections for and prompt identification and removal of ticks) are essential for disease prevention. This report summarizes incident diagnoses and medical event reports of Lyme disease among U.S. military members from 2001 through 2008.

Methods:

The surveillance period was 1 January 2001 to 31 December 2008. The surveillance population included all active and Reserve component members of the U.S. Armed Forces. All data were derived from inpatient, outpatient, and reportable medical event records maintained in the Defense Medical Surveillance System (DMSS). For surveillance purposes, a "confirmed case" of Lyme disease was defined by a hospitalization with a diagnosis of "Lyme disease" (ICD-9-CM: 088.81) in any of the first three diagnostic positions; a notifiable medical event report of Lyme disease; or at least

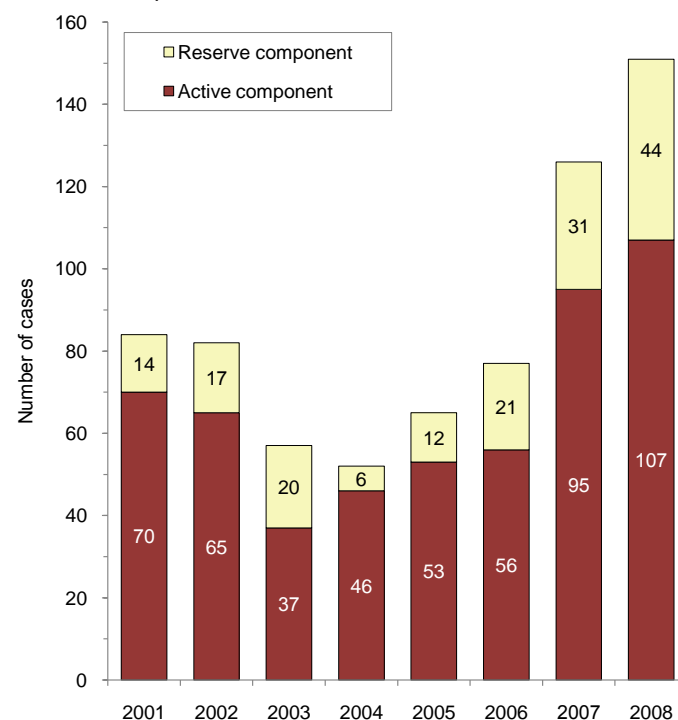
Table 1. Incident cases of Lyme disease, active and Reserve components, U.S. Armed Forces, 2001-2008

	Active component		Reserve component		Total	
	Confirmed*	Possible†	Confirmed	Possible	Confirmed	Possible
Total 2001-2008	529	1,803	165	725	694	2,528
2001	70	224	14	61	84	285
2002	65	228	17	86	82	314
2003	37	188	20	92	57	280
2004	46	236	6	70	52	306
2005	53	215	12	85	65	300
2006	56	242	21	84	77	326
2007	95	218	31	126	126	344
2008	107	252	44	121	151	373

*Hospitalization (dx1-3), notifiable event report or at least 3 ambulatory visits (dx1) separated by at least 7 days with a diagnosis of "Lyme disease" (ICD-9-CM: 088.8)

†One or more ambulatory visits that did not meet the "confirmed case" definition.

Figure 1. Confirmed cases* of Lyme disease, active and Reserve components, U.S. Armed Forces, 2001-2008



*"Confirmed cases" are defined as hospitalizations (dx1-3), notifiable event reports or at least three ambulatory visits (dx1) separated by at least 7 days with a diagnosis of "Lyme disease" (ICD-9-CM: 088.81).

three ambulatory visits (separated by at least 7 days) with primary (first-listed) diagnoses of Lyme disease. A “possible case” of Lyme disease was defined as one or more ambulatory encounters that did not meet the “confirmed case” definition. Each individual was counted as a case only once during the surveillance period. Incidence rates were calculated for members of the active components of the Services.

Results:

During the 8-year surveillance period, there were 3,222 service members with diagnoses or case reports of Lyme disease; of these, 694 (21.5%) were considered “confirmed cases” (by the surveillance case definition) (Table 1).

Three-fourths (76.2%) of all confirmed cases were diagnosed/reported among active component service members. Among both active and Reserve component members, confirmed cases declined or were relatively stable from 2001 to 2006 and then sharply increased through 2008. There were nearly three-times more confirmed cases in 2008 (n=151) than in 2004 (n=52) (Table 1, Figure 1).

Among active component members, annual incidence rates of confirmed cases declined from 2001 (0.50 per 10,000 person-years [p-yrs]) to 2003 (0.26 per 10,000 p-yrs), increased moderately from 2003 to 2006 (0.40 per 10,000 p-yrs), and increased sharply from 2006 to 2008 (0.75 per 10,000 p-yrs). Overall, there was no clear trend in incidence rates of possible cases; however, the highest annual rate during

the period was in 2008 (1.78 per 10,000 p-yrs) (Figure 2).

Service members diagnosed or reported with confirmed cases of Lyme disease were generally white, non-Hispanic (80%), males (82%) and tended to be in their late 30s (19%) or early 40s (25%) (data not shown). The majority of confirmed cases (60%) were diagnosed/reported between May and August; approximately 19% of all confirmed cases were diagnosed or reported in July (Figure 3).

Among service members, confirmed cases of Lyme disease were diagnosed at more than 120 locations worldwide. Medical facilities at the following 12 locations had more than 10 confirmed cases each (together, they accounted for nearly one-half of the total): West Point, NY (n=58); Heidelberg, GE (n=49); Walter Reed Army Medical Center, Washington, DC (n=36); Camp Lejeune, NC (n=34); Vilseck, GE (n=34); Landstuhl Regional Medical Center, GE

Table 2. Lyme disease by location of diagnosis, active and Reserve components, U.S. Armed Forces, 2001-2008

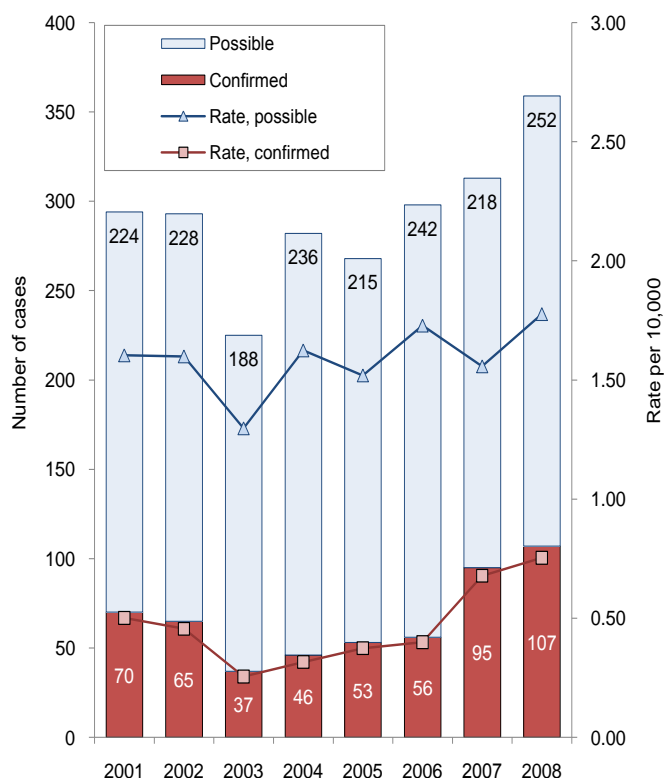
Installation	State or Country	Confirmed cases	Possible cases
West Point	NY	58	70
Heidelberg	Germany	49	74
Walter Reed Army Medical Ctr	DC	36	77
Camp Lejeune	NC	34	116
Vilseck	Germany	34	38
Landstuhl Regional Medical Ctr	Germany	33	41
Naval Health Clinic New England	CT*	23	131
NNMC Bethesda	MD	20	87
Fort Knox	KY	17	78
Andrews Air Force Base	MD	15	40
Fort Meade	MD	14	91
McGuire Air Force Base	NJ	13	67

*Cases diagnosed in multiple states. Confirmed cases diagnosed in CT (15), RI (5), NH (1), ME (1), and NY (1).

(n=33); Naval Health Clinic New England (branch clinics in Newport, RI; Groton, CT; Portsmouth, NH; Brunswick, ME; Saratoga Springs, NY (n=23); National Naval Medical Center, Bethesda, MD (n=20); Fort Knox, KY (n=17); Andrews Air Force Base, MD (n=15); Fort Meade, MD (n=14); and McGuire Air Force Base, NJ (n=13) (Table 2).

Locations with the most “possible cases” (but fewer than 10 confirmed cases each) include Portsmouth, VA (possible: 94; confirmed: 6); Marine Corps Base Quantico, VA (possible: 73; confirmed: 4); Fort Bragg, NC (possible: 63; confirmed: 6); Fort Leonard Wood, MO (possible: 45; confirmed: 8); and Fort Belvoir, VA (possible: 32; confirmed: 5) (data not shown).

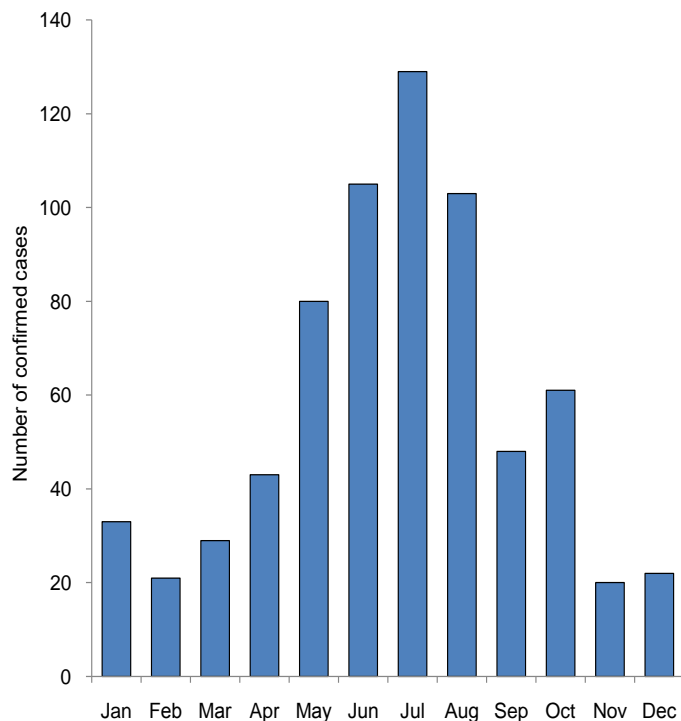
Figure 2. Numbers and rates of “confirmed” and “possible” cases of Lyme disease, active component, U.S. Armed Forces, 2001-2008



Editorial comment:

Lyme disease is the most common tick transmitted infectious disease of humans in North America and Europe.⁴

Figure 3. Confirmed cases* of Lyme disease, by month, active and Reserve components, 2001-2008



In 2008, there were more than 150 confirmed cases and nearly 375 possible cases of Lyme disease among U.S. service members; in 2008 compared to 2005, there were 24% more “possible cases” and 2.3 times more “confirmed” cases among military members. Not surprisingly, most confirmed and possible cases among military members were reported from late spring through summer from installations in Lyme disease endemic areas of the United States and Europe.

Lyme disease is often difficult to diagnosis definitively because the signs, symptoms, and clinical courses are highly variable and non-specific. In general, the diagnosis relies on assessments of symptoms (e.g., headache, joint pains, malaise), physical findings (e.g., fever, rash, facial palsy), and exposure histories (e.g., tick bites in endemic areas). While erythema migrans is a distinctive early manifestation, it does not occur in all cases, may not have the characteristic bull’s eye appearance, and may not be accompanied by other signs and symptoms of acute infection (e.g., fever, headache).

There are several laboratory tests for Lyme disease, but their reliability markedly varies. For example, tests that detect antibodies produced in response to recent infections may be falsely “negative” at the time of first clinical manifestations; the same tests may be very sensitive when used later in the clinical courses. The U.S. Centers for Disease Control and Prevention (CDC) recommends a two-step regimen when testing serum for evidence of *Borrelia* infection: the first step is an ELISA or IFA which is highly sensitive but not specific; the second step (conducted if the first test is positive) is a Western blot which is highly specific. Positive results on both

tests reliably document *Borrelia*-specific antibodies. Because information regarding diagnostic tests is not routinely integrated in the Defense Medical Surveillance System (DMSS), this report does not account for the numbers, types, or results of laboratory tests conducted during clinical assessments of “confirmed” and “possible” cases.

It is unclear if the recent increases in diagnosed cases of Lyme diseases among military members reflect increasing incidence of disease, more complete ascertainment and reporting of “true” cases, or increased reporting of clinically suggestive but not true (“false positive”) cases. The results of this report should be interpreted with this uncertainty in mind.

Often, military training and operations are conducted outdoors in tick-infested areas. In such circumstances, military members must have the knowledge, equipment, supplies, and motivation necessary to protect themselves from tick-transmitted infections such as Lyme disease. While conducting military activities in tick infested areas, all service members should use permethrin-treated uniforms; use military issued (DEET containing) insect repellent on exposed skin; keep sleeves rolled down and trouser legs tucked inside boots; and routinely inspect skin surfaces to identify and carefully remove ticks. Military leaders at all levels must ensure that service members are knowledgeable regarding and apply personal protective measures as indicated.

During off-duty activities (e.g., hiking, camping, landscaping), military members, their family members, and friends should avoid tick infested areas if possible. Otherwise, they should wear long-sleeved shirts, long pants, and high socks; use DEET-containing repellents on exposed skin; tuck shirts into pants and pant legs into socks; check skin and clothing periodically while in, and thoroughly inspect for and remove ticks after leaving, tick habitats.

Information regarding Lyme disease (including instructions for removing attached ticks) is available from the U.S. Army Center for Health Promotion and Preventive Medicine (USACHPPM) at: <http://chppm-www.apgea.army.mil/documents/FACT/18-011-0406-LymeDiseaseJTF-April2006.pdf> and the CDC at: http://www.cdc.gov/ncidod/dvbid/lyme/ld_prevent.htm.

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Asthma, Active Component, U.S. Armed Forces, 1999-2008

Asthma is a chronic disease of the lungs characterized by inflammation, bronchospasm, airway hyperreactivity and reversible obstruction. Asthma is notable for its variable clinical course and recurring symptoms; yet, “not all asthma wheezes, and all that wheezes is not asthma.” Exacerbations often occur in response to environmental “triggers” or acute respiratory disease. The clinical manifestations of asthma range from mild shortness of breath to dyspnea, hypoxia, and life threatening cardiorespiratory arrest.¹⁻⁴

Among military members, asthma can require acute and long term treatment regimens, evacuation from field training and operational settings, and disqualification from active service. Military members often have their first lifetime diagnoses of asthma after they begin military service.⁴⁻⁷

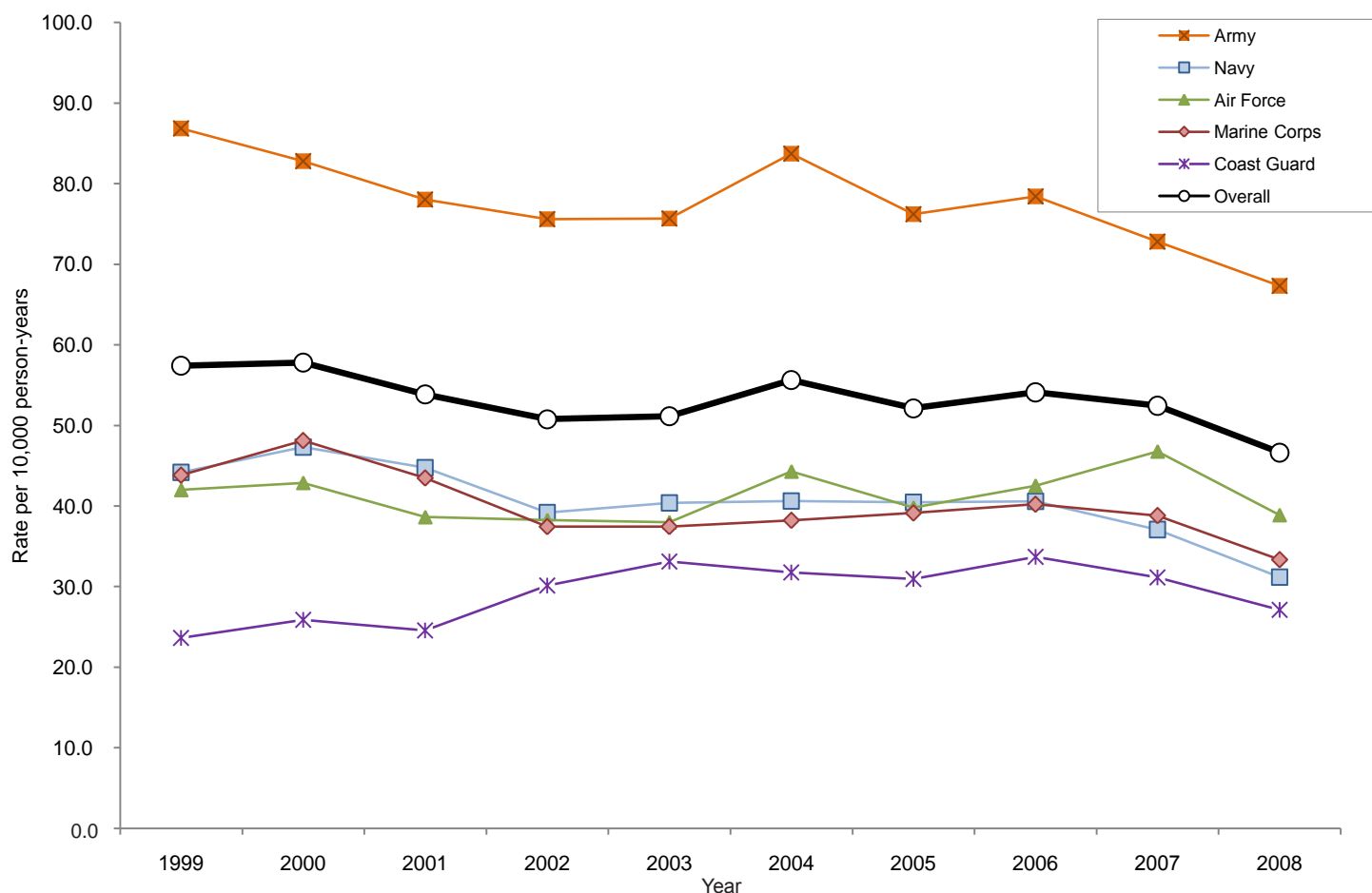
There are numerous and varied triggers of clinical exacerbations of asthma, including airborne allergens, airway irritants, infectious agents, and physical exertion. Asthma triggers vary among affected individuals. During their service careers, military members are exposed to many infectious

agents and allergens that are novel to them or vary across assignment locations, operational settings, and activities. Asthma that becomes exacerbated by physical exertion or in austere environments without reliable access to necessary medications can limit duty performance, compromise safety, decrease unit effectiveness, and increase costs associated with hospitalization, medical evacuation, and early discharge from service.⁴⁻⁸

For several reasons, the incidence and impacts of asthma among active military members are difficult to quantify. For example, applicants for military service may deny histories of asthma, military trainees may not seek care for asthma symptoms (e.g., for fear of missing essential training), and health care providers may over or underreport asthma diagnoses on medical records. Concepts of asthma pathogenesis have evolved over the past several decades; still, an objective screening test predictive of the likelihood or severity of future attacks remains elusive.^{1,4}

Based on results of prospective studies of recruits with histories of childhood asthma, DoD accession standards

Figure 1. Crude rates of incident diagnoses of “asthma,” active component members, U.S. Armed Forces, by year, 1998-2008



regarding asthma were modified in 2004.⁴ Since then, asthma has been considered a cause for rejection from service if it was "... reliably diagnosed and symptomatic after the 13th birthday."⁴ However, asthma remains one of the most common pre-service conditions leading to discharge, with more than 700 recruits discharged annually for asthma during their first six months of service.⁹

This report documents military and demographic characteristics of service members who are diagnosed with asthma; frequencies, rates, and trends of incident asthma diagnoses; and health care utilization of service members after incident asthma diagnoses among members of the active component of the U.S. Armed Forces from 1999 through 2008.

Methods:

The surveillance period was 1 January 1999 to 31 December 2008. The surveillance population included all individuals who served in the active component of the U.S. Armed Forces at any time during the surveillance period. All data were derived from electronic records maintained in the Defense Medical Surveillance System (DMSS).

For surveillance purposes, an incident case was defined as an individual's first hospitalization or second ambulatory

encounter during the surveillance period that was documented with a diagnosis of "asthma" (ICD-9: 493.0-9) in any diagnostic position.

To assess the relationship between the locations of service members' residences prior to service and the risk of asthma while in service, we compared the numbers of "observed" and "expected" asthma cases among service members whose residences prior to service were in the same 3-digit ZIP code regions. "Expected" asthma cases among service members from each 3-digit ZIP code region were calculated by multiplying the total incident asthma cases among service members overall by the proportion of all service members who resided in each 3-digit ZIP code region prior to service.

Results:

From 1999 through 2008, there were 75,278 incident diagnoses of asthma among active component members of the U.S. Armed Forces. During the 10-year period, the crude incidence rate (IR) was 53.2 per 10,000 person-years (p-yrs) of service. On average, service members had four subsequent asthma-specific clinical encounters after their incident diagnosis.

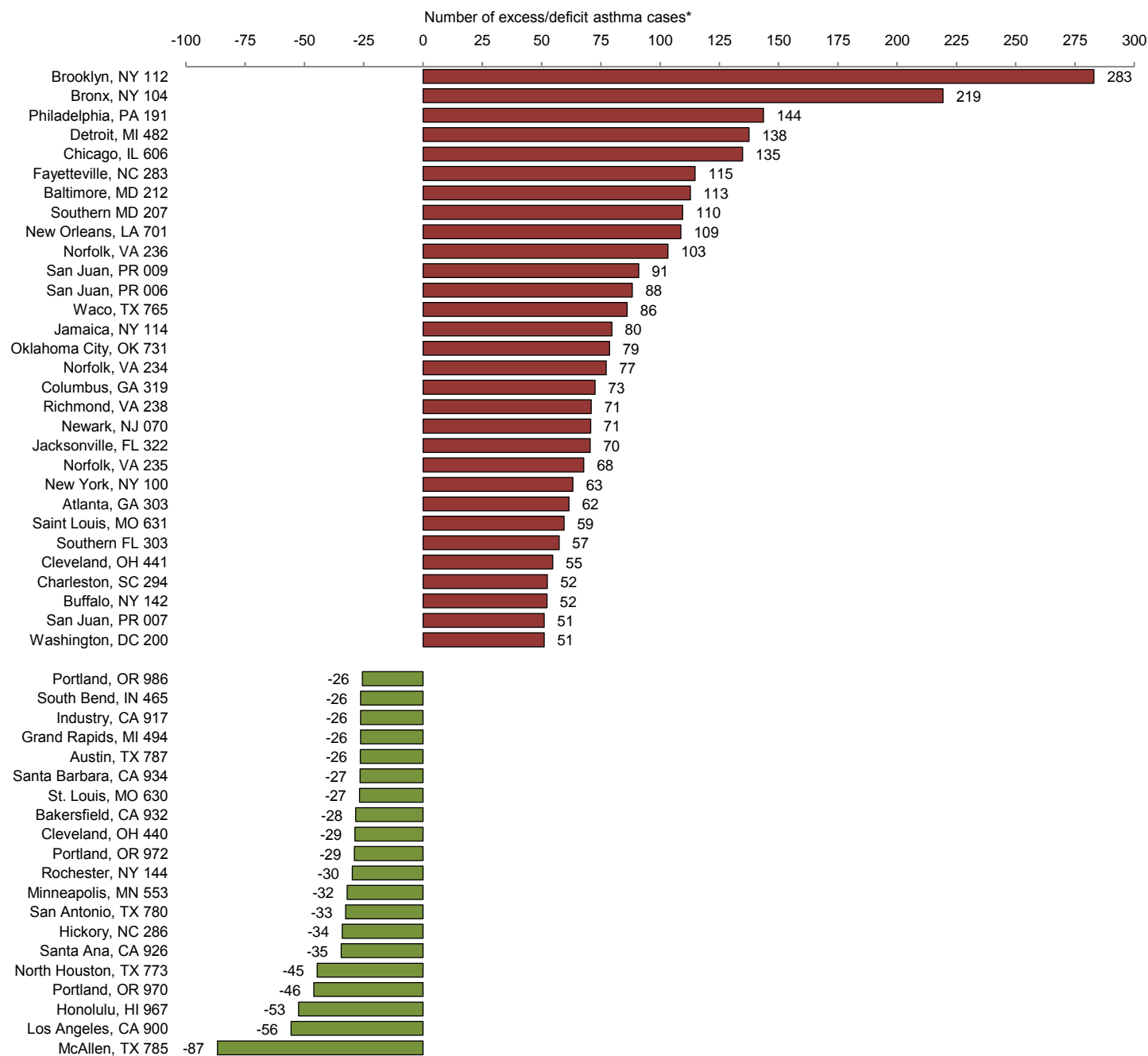
Among active military members overall, annual incidence rates of asthma were stable from 1999 to 2000, declined from 2000 through 2002, were stable from 2002

Table 1. Incident diagnoses of asthma, active components, U.S. Armed Forces, 1999-2008

	1999		2000		2001		2002		2003		2004		2005		2006		2007		2008		Total	
	No.	Rate*	No.	Rate	No.	Rate	No.	Rate	No.	Rate	No.	Rate	No.	Rate	No.	Rate	No.	Rate	No.	Rate	No.	Rate
Total	8,033	57.4	8,076	58.5	7,524	53.9	7,241	50.8	7,413	51.2	8,088	55.6	7,380	52.1	7,583	54.1	7,347	50.5	6,623	46.6	75,278	53.2
Service																						
Army	4,068	86.9	3,923	83.6	3,699	78.0	3,632	75.6	3,708	75.7	4,124	83.7	3,703	76.2	3,863	78.4	3,714	72.8	3,578	67.3	38,012	77.6
Navy	1,607	44.2	1,729	47.9	1,648	44.8	1,478	38.3	1,508	40.6	1,458	39.3	1,450	40.5	1,403	40.6	1,238	37.1	1,022	31.2	14,604	40.7
Air Force	1,497	42.0	1,508	43.5	1,345	42.9	1,377	38.3	1,657	44.3	1,641	43.9	1,407	39.8	1,466	42.5	1,560	46.8	1,263	38.9	14,475	41.2
Marine Corps	750	43.8	826	49.0	746	43.5	644	37.4	675	38.2	665	37.7	698	39.1	717	40.2	709	38.8	648	33.3	7,075	39.9
Coast Guard	81	23.7	90	27.6	86	24.6	110	30.2	124	31.8	120	30.7	122	30.9	134	33.7	126	31.1	112	27.1	1,112	29.4
Sex																						
Male	5,812	48.5	5,688	47.8	5,297	44.4	5,051	41.6	5,614	45.3	5,575	45.0	5,107	42.2	5,210	43.5	5,055	42.1	4,521	37.1	52,565	43.4
Female	2,191	111.6	2,388	122.7	2,227	108.6	2,190	103.5	2,474	115.0	2,437	113.3	2,273	110.5	2,373	117.3	2,292	114.3	2,102	104.4	22,713	110.6
Age																						
<20	1,490	107.4	1,654	113.1	1,483	91.7	1,403	86.5	1,383	89.3	1,505	102.7	1,227	94.1	1,232	98.3	1,236	98.0	1,034	81.6	13,647	95.9
20-29	3,910	55.2	3,996	56.3	3,779	52.8	3,705	49.9	3,879	50.0	4,349	54.9	3,898	49.8	4,098	52.4	4,076	52.0	3,591	45.0	39,281	51.7
30-39	1,996	47.0	1,777	44.0	1,646	41.3	1,521	38.4	1,543	39.4	1,593	41.5	1,536	41.4	1,551	42.6	1,405	38.7	1,344	36.9	15,912	41.1
40+	607	49.7	649	53.7	616	50.8	612	48.7	608	47.6	641	48.6	719	54.6	702	54.3	630	49.3	654	50.5	6,438	50.8
Race/ethnicity																						
White, non-Hisp	4,324	50.0	4,643	53.3	4,333	49.2	4,216	46.9	4,248	46.5	4,679	51.0	4,277	47.9	4,326	48.8	4,198	47.2	3,792	42.0	43,036	48.2
Black, non-Hisp	2,192	80.8	2,161	80.0	2,048	74.6	1,955	71.5	1,851	68.7	2,014	77.3	1,836	74.8	1,873	79.5	1,778	77.3	1,569	68.1	19,277	75.2
Other	1,487	57.8	1,272	53.5	1,143	47.3	1,070	42.1	1,314	49.2	1,395	50.6	1,267	45.8	1,384	49.6	1,371	48.7	1,262	44.2	12,965	48.8
Military occupation																						
Combat	1,088	38.3	1,128	40.1	1,104	39.4	1,049	37.2	1,048	36.5	1,246	42.6	1,057	35.3	1,462	50.3	1,019	34.7	962	32.2	11,152	38.6
Health Care	885	75.4	842	73.2	816	70.4	788	67.5	882	74.9	872	73.7	819	70.7	842	72.7	809	70.2	738	64.2	8,287	71.3
Other	6,030	60.7	6,210	62.1	5,604	56.0	5,404	52.6	5,483	52.5	5,970	57.3	5,504	55.0	5,279	53.1	5,519	55.6	4,923	48.9	55,839	55.3

*Rate per 10,000 person-years of service

Figure 2. Locations of residence (3-digit ZIP code) prior to entry to military service that are associated with the largest estimated excesses/deficits of asthma cases among active component service members, U.S. Armed Forces



*In excess/deficit of the number of asthma cases that would be expected based on the rate for applicants from all locations combined

through 2006, and sharply declined from 2006 through 2008 (**Figure 1**).

During each year of the period, incidence rates were much higher in the Army than the other services (**Figure 1**). In relation to age, rates were highest among the youngest service members (<20 years: 95.9 per 10,000 p-yrs) and lowest among those in their thirties (30-39 years: 41.1 per 10,000 p-yrs). While rates were not extreme among service members in their twenties, the age group accounted for more than one-half of all incident cases (20-29 years: 51.7 per 10,000 p-yrs; n=39,281). Overall

incidence rates were more than 50% higher among service members who were black non-Hispanic (75.2 per 10,000 p-yrs) than white non-Hispanic or "other" race-ethnicities (**Table 1**).

Throughout the period, incidence rates of asthma were approximately 2.5-times higher among females than males; however, among both females and males, incidence rates generally declined, particularly from 2006 to 2008.

Overall, the incidence rate was more than 80% higher among service members in health care (IR: 71.3 per 10,000 p-yrs) than combat-specific (IR: 38.6 per 10,000 p-yrs)

occupations. At least in part, the difference reflects the much higher proportion of females among service members in health care than combat-specific occupations (data not shown).

In nearly one of every eight incident asthma cases ($n=9,231$; 12.3%), the case defining medical encounter was a hospitalization. In contrast to the declining rates of asthma diagnoses overall (particularly in recent years), case defining hospitalizations increased by nearly 50% from 2004 ($n=755$) to 2008 ($n=1,169$); and among females, case defining hospitalizations increased by nearly 85% from 2003 ($n=280$) to 2008 ($n=520$) (data not shown).

Large urban areas in north-central and north-eastern states — particularly, Brooklyn and Bronx, NY; Philadelphia, PA; Detroit, MI; Chicago, IL; and Baltimore, MD — were overrepresented as prior residences of service members who were diagnosed with asthma in military service. Areas of Texas and Pacific coastal states — including California, Oregon, and Hawaii — were underrepresented as prior residences of service members diagnosed with asthma in military service (Figure 2).

Editorial Comment:

This report documents a generally decreasing incidence of asthma diagnoses among U.S. military members in the past eleven years — and particularly since 2006. Relative to their respective counterparts in the active component, incidence rates of asthma are much higher among service members who are in the Army, female, black non-Hispanic, younger than 20 years old, and in health care occupations.

The findings of this report are generally consistent with previous observations regarding asthma hospitalizations of U.S. military personnel.⁴ For example, in 2005, Gunderson and colleagues summarized incident asthma-related hospitalizations among enlisted members of the U.S. Navy from 1980 to 1999. They reported significantly higher rates among sailors who were female and black; notably, incidence rates (age-adjusted) doubled during the 20-year period.⁶ In 2007, Hansen and colleagues reported that asthma hospitalizations among U.S. military members declined by more than 40% from 1994 to 2004; service members who were female, health care workers, and in the Army had significantly higher risk. The authors noted that improvements in outpatient management strategies (e.g., medications, treatment regimens) likely contributed to the sharp decline in asthma hospitalizations during the period.⁷

In the U.S. military, incident diagnoses of asthma have generally declined since 2000; however, since 2004, hospitalizations as initial medical encounters for “new” cases have been increasing. The finding suggests that first episodes of asthma while on active duty may be increasing in severity — or that non-specific diagnoses are more frequently used

for patients (with no documented histories of asthma) who are treated for asthma-like symptoms in ambulatory settings.

A study at the Great Lakes Naval Training Center from 2000 to 2002 found that recruits diagnosed with mild asthma during training had higher attrition from service and used more health care than their counterparts; of note, there were no asthma-related hospitalizations or deaths among the 136 asthmatic trainees.¹⁰ In 2004, the DoD relaxed its rigid consideration of lifelong history of asthma as a disqualifying factor for military service. Since 2004, only applicants with relatively recent (since age 13) histories of asthma and active disease have been medically disqualified.⁴ Perhaps, some individuals who would have been excluded from service prior to 2004 had severe exacerbations of asthma (and required hospital treatment) after entering military service.

Each military service implements its own waiver process based on personnel demands and occupational requirements. In addition to potential differences in standards of fitness for duty, there may be service-unique environmental triggers. In a study of 222 asymptomatic, healthy military members in 2007, Morris and colleagues found that approximately one of 7 (14%) had airway obstruction (documented on spirometry); and of these, nearly one-fourth (23%) had increased airway hyper-reactivity after a 1.5 mile run.¹¹ Perhaps, differences in the natures and locations of training and operational activities account at least in part for the higher rates of asthma in the Army than the other Services.

The CDC estimates that asthma-related hospitalization and outpatient visit rates are approximately 35% and 20% higher among women than men, respectively. Interestingly, relationships between asthma risk and gender reverse from childhood to adulthood: among children, males have higher risk; among adults, females are more likely to have asthma. Gender disparities in asthma risk are active areas of research.³

In the United States, asthma is much more common in urban than rural areas. The increased risk in city dwellers has been associated with air pollution (indoor and outdoor), infestation-related allergens (e.g., cockroaches, mice, rats), and stress (e.g., violence).¹² This report suggests that asthma risk while in military service may be associated with the location of residence prior to service; those from the largest cities in the north and north-east U.S. seem to be at relatively high risk. The finding is interesting but not conclusive; for example, there are likely significant differences in the demographic characteristics (e.g., race-ethnicity) of service members from large urban versus rural areas. Multivariate analyses that account for such differences are necessary to reliably estimate the independent effects on asthma risk of black race and urban residence prior to service.

There are significant limitations to this summary that should be considered when interpreting the results. For example, cases of “asthma” were ascertained from diagnoses reported on standardized hospitalization and ambulatory

medical records. However, the clinical criteria used to support diagnoses of "asthma" were not documented and thus could not be used to define "cases" for the analysis. Also, the case definition of asthma used for the analysis was constrained by the nonavailability of ambulatory data prior to 1998; as a result, some apparently "new cases" of asthma during the surveillance period were likely "old cases" that were diagnosed (but not documented in the Defense Medical Surveillance System) prior to the surveillance period. In addition, the clinical settings where diagnoses were recorded were not accounted for in the analysis; the reliability of "asthma" diagnoses likely differs among cases reported during emergency department visits, after "sick call" visits, after specialty care clinic evaluations (e.g., allergy/immunology), or on hospital discharge records.

In summary, asthma continues to be a significant cause of morbidity and disability among U.S. service members; as such, it is associated with significant costs to the military in general and the Military Health System in particular. As outpatient management regimens improve, service members with asthma will be better able to perform all required military activities without undue risk to their own health or their military unit's mission.

Reported by Cecili K. Sessions, Maj, MC, USAF.

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Update: Deployment Health Assessments, U.S. Armed Forces, June 2009

Since January 2003, peaks and troughs in the numbers of pre- and post-deployment health assessment forms transmitted to the Armed Forces Health Surveillance Center generally corresponded to times of departure and return of large numbers of deployers. Since April 2006, numbers of post-deployment health reassessments (PDHRA) transmitted per month have ranged from 17,000 to 36,000 (**Table 1, Figure 1**).

During the past 12 months, the proportions of returned deployers who rated their health as “fair” or “poor” were 8-11% on post-deployment health assessment questionnaires and 11-14% on PDHRA questionnaires (**Figure 2**).

In general, on post-deployment assessments and reassessments, deployers in the Army and in reserve components were more likely than their respective counterparts to report health and exposure-related concerns (**Table 2, Figure 2**). Both active and reserve component members were more likely to report exposure concerns three to six months after compared to the time of return from deployment (**Figure 3**).

At the time of return from deployment, soldiers serving in the active component were the most likely of all deployers to receive mental health referrals; however, three to six months after returning, active component soldiers were less likely than Army and Marine Corps Reservists to receive mental health referrals (**Table 2**).

Finally, during the past three years, reserve component members have been more likely than active to report “exposure concerns” on post-deployment assessments and reassessments (**Figure 3**).

Table 1. Deployment-related health assessment forms, by month, U.S. Armed Forces, July 2008-June 2009

	Pre-deployment assessment DD2795		Post-deployment assessment DD2796		Post-deployment reassessment DD2900	
	No.	%	No.	%	No.	%
Total	435,610	100	355,224	100	308,552	100
2008						
July	26,194	6.0	25,514	7.2	21,454	7.0
August	33,831	7.8	22,828	6.4	30,104	9.8
September	39,279	9.0	33,508	9.4	25,877	8.4
October	38,670	8.9	38,057	10.7	26,305	8.5
November	28,423	6.5	37,804	10.6	23,407	7.6
December	36,752	8.4	40,338	11.4	21,431	6.9
2009						
January	42,877	9.8	31,707	8.9	25,568	8.3
February	36,388	8.4	28,259	8.0	27,522	8.9
March	37,893	8.7	23,624	6.7	30,379	9.8
April	41,045	9.4	18,357	5.2	29,614	9.6
May	34,194	7.8	27,875	7.8	23,823	7.7
June	40,064	9.2	27,353	7.7	23,068	7.5

Figure 2. Proportion of deployment health assessment forms with self-assessed health status as “fair” or “poor”, U.S. Armed Forces, July 2008-June 2009

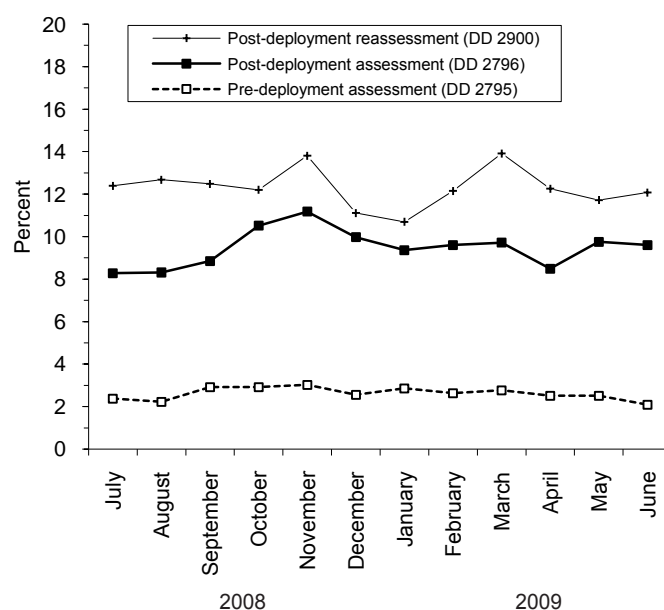


Figure 1. Total deployment health assessment and reassessment forms, by month, U.S. Armed Forces, January 2003-June 2009

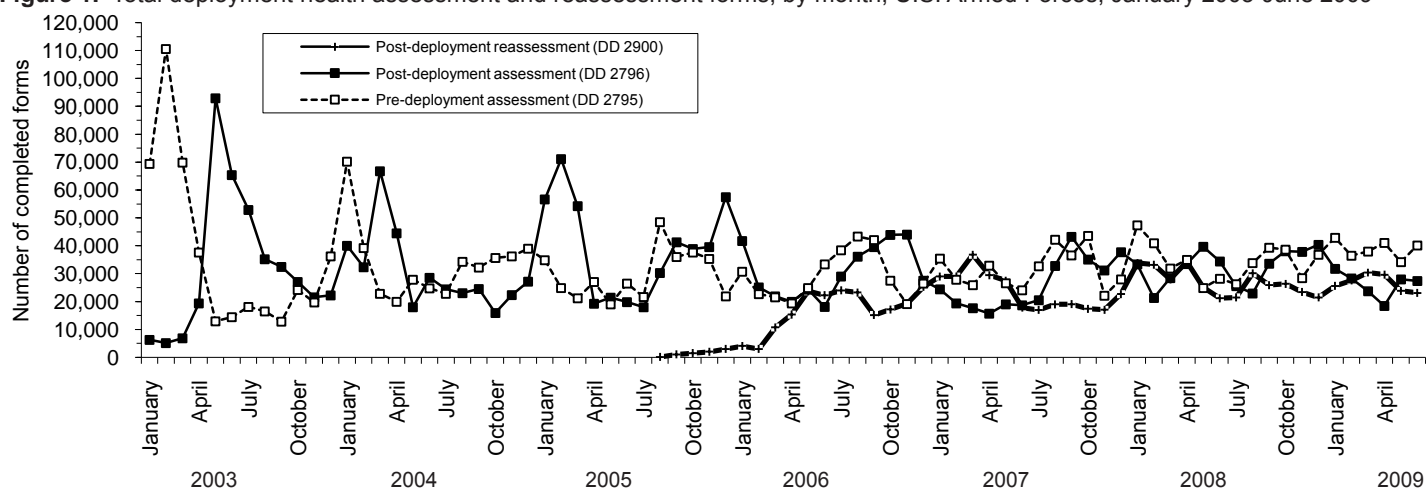
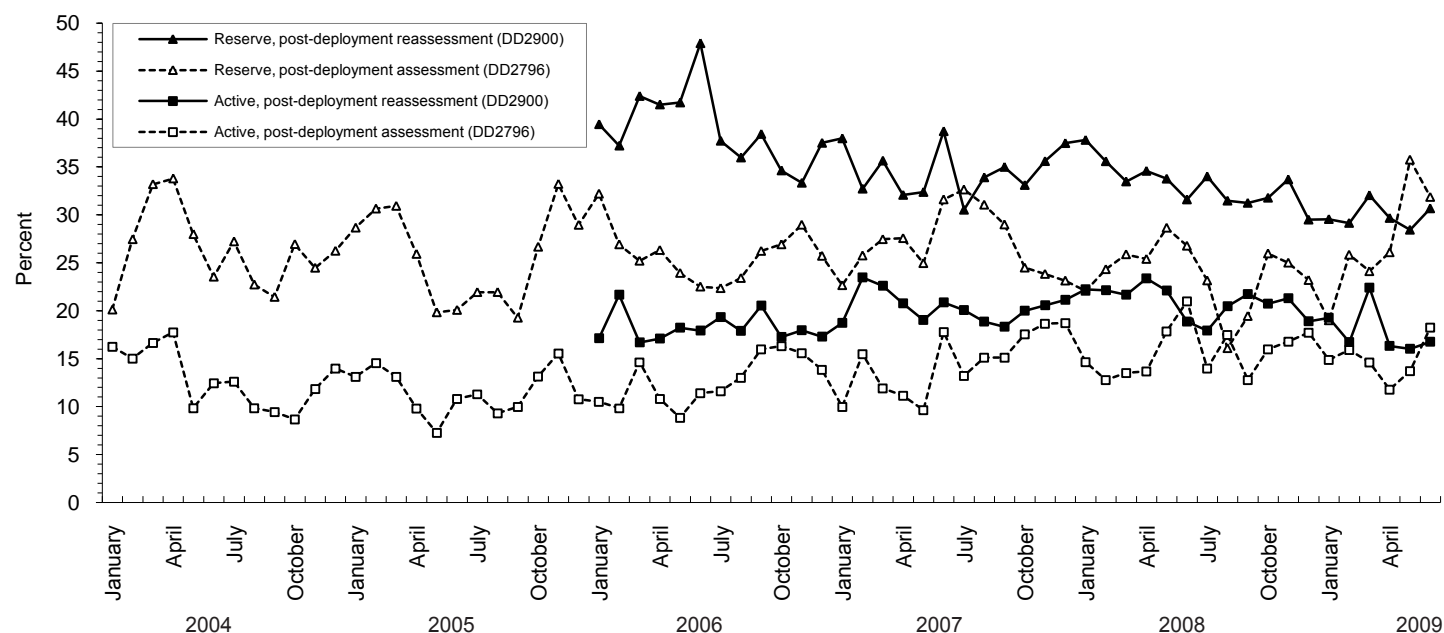


Table 2. Percentage of service members who endorsed selected questions/received referrals on health assessment forms, U.S. Armed Forces, July 2008-June 2009

	Army			Navy			Air Force			Marine Corps			All service members		
	Pre-deploy DD2795	Post-deploy DD2796	Reassess DD2900	Pre-deploy DD2795	Post-deploy DD2796	Reassess DD2900	Pre-deploy DD2795	Post-deploy DD2796	Reassess DD2900	Pre-deploy DD2795	Post-deploy DD2796	Reassess DD2900	Pre-deploy DD2795	Post-deploy DD2796	Reassess DD2900
Active component	n=150,455	n=125,348	n=116,922	n=11,831	n=16,075	n=14,121	n=58,343	n=51,305	n=52,042	n=22,858	n=31,258	n=32,584	n=243,487	n=223,986	n=215,669
	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%
General health "fair" or "poor"	4.1	11.2	14.8	1.3	4.7	6.0	0.5	3.7	4.3	1.7	6.5	9.2	2.9	8.4	10.8
Health concerns, not wound or injury	16.4	25.3	25.0	3.8	14.2	14.1	1.4	5.7	11.1	3.3	13.8	17.8	11.0	18.4	19.8
Health worse now than before deployed	na	0.5	26.3	na	0.0	13.9	na	0.0	9.1	na	0.0	18.2	na	0.3	20.1
Exposure concerns	na	16.8	20.9	na	17.0	16.4	na	10.5	14.9	na	14.6	19.4	na	15.1	18.9
PTSD symptoms (2 or more)	na	10.4	13.8	na	4.4	7.3	na	2.2	2.7	na	4.5	8.8	na	7.2	9.9
Depression symptoms (any)	na	0.6	34.3	na	0.0	24.8	na	0.0	14.6	na	0.2	31.0	na	0.4	28.4
Referral indicated by provider (any)	5.4	34.0	20.3	5.1	24.0	15.3	1.7	10.7	6.7	3.2	21.6	21.5	4.3	26.2	16.9
Mental health referral indicated*	1.1	7.5	6.5	0.6	4.1	5.7	0.5	1.1	2.0	0.3	2.6	4.6	0.8	5.1	5.1
Medical visit following referral†	93.1	98.9	95.2	86.8	79.7	89.9	77.2	96.1	97.6	59.4	71.8	75.0	88.5	92.2	91.2
Reserve component	n=85,763	n=52,708	n=60,498	n=3,213	n=3,669	n=6,234	n=16,049	n=15,245	n=17,133	n=2,008	n=3,132	n=5,436	n=107,033	n=74,754	n=89,301
	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%
General health "fair" or "poor"	1.9	12.0	18.9	0.6	8.9	8.7	0.3	5.2	4.6	1.3	8.7	9.5	1.6	10.4	14.9
Health concerns, not wound or injury	14.0	34.7	47.2	2.7	28.2	29.6	0.6	9.2	13.6	3.3	29.5	32.6	11.4	29.0	38.6
Health worse now than before deployed	na	1.5	36.1	na	0.1	22.4	na	0.0	10.5	na	0.2	25.0	na	1.1	29.5
Exposure concerns	na	24.3	34.5	na	33.2	27.8	na	19.6	20.9	na	22.0	26.9	na	23.7	31.0
PTSD symptoms (2 or more)	na	9.7	23.2	na	5.9	10.3	na	2.1	2.7	na	5.4	12.9	na	7.8	17.7
Depression symptoms (any)	na	1.7	39.0	na	0.1	24.8	na	0.0	14.0	na	0.3	30.8	na	1.2	32.7
Referral indicated by provider (any)	4.0	38.4	34.8	4.1	30.7	18.2	0.6	13.3	5.5	3.9	32.9	29.3	3.5	32.7	27.7
Mental health referral indicated*	0.5	5.1	13.1	0.4	3.5	4.6	0.0	0.6	0.9	0.4	3.2	9.5	0.4	4.0	10.0
Medical visit following referral†	95.4	97.7	33.0	92.1	89.9	39.6	36.4	65.6	38.0	57.1	59.8	23.4	91.6	92.3	32.9

*Includes behavioral health, combat stress and substance abuse referrals.

†Record of inpatient or outpatient visit within 6 months after referral.

Figure 3. Proportion of service members who endorsed exposure concerns on post-deployment health assessments, U.S. Armed Forces, January 2004-June 2009

Sentinel reportable events for service members and beneficiaries at U.S. Army medical facilities, cumulative numbers* for calendar years through 30 June 2008 and 30 June 2009



Army

Reporting locations	Number of reports all events†		Food-borne								Vaccine preventable					
			Campylo-bacter		Giardia		Salmonella		Shigella		Hepatitis A		Hepatitis B		Varicella	
	2008	2009	2008	2009	2008	2009	2008	2009	2008	2009	2008	2009	2008	2009	2008	2009
NORTH ATLANTIC																
Washington, DC Area	195	243	1	1	2	1	1	.	.	.	1	.	2	1	6	1
Aberdeen, MD	15	3	.	.	.	.	.	.	.	.	.	.	.	.	.	.
FT Belvoir, VA	144	124	2	4	.	.	3	2	1	.	.	.	.	.	.	.
FT Bragg, NC	814	956	.	3	.	.	7	7	.	.	.	.	.	2	.	.
FT Drum, NY	201	34	.	.	.	.	.	.	.	.	.	.	.	.	.	.
FT Eustis, VA	417	132	.	.	.	1	.	1	.	.	.	.	.	.	.	.
FT Knox, KY	378	118	2	.	.	.	.	.	.	.	.	.	.	.	.	.
FT Lee, VA	182	255	.	.	.	.	.	.	.	.	.	.	3	.	1	.
FT Meade, MD	192	38	.	.	1	.	.	.	.	.	.	.	.	.	.	.
West Point, NY	53	109	.	1	.	.	.	.	.	.	.	.	1	1	.	.
GREAT PLAINS																
FT Sam Houston, TX	446	484	.	1	.	3	5	2	9	.	.	.	.	1	.	1
FT Bliss, TX	286	415	.	.	.	.	5	1	.	1	.	1	.	5	.	.
FT Carson, CO	492	497	1	1	.	.	2	1	.	.	.	.	1	.	.	.
FT Hood, TX	1,228	1,198	3	7	.	.	14	11	5	5	.	.	.	.	2	.
FT Huachuca, AZ	48	60	.	.	.	.	1	.	1	.	.	.	.	.	.	.
FT Leavenworth, KS	24	36	.	.	.	.	.	.	.	.	.	.	.	.	.	.
FT Leonard Wood, MO	338	289	.	1	2	.	1	.	.	.	1	1	1	.	1	1
FT Polk, LA	95	291	1	.	.	3	.	.	1	1	.	.	.	.	1	.
FT Riley, KS	302	361	.	.	.	.	1	2	.	.	.	.	2	.	.	.
FT Sill, OK	153	153	.	.	.	.	.	.	.	2	.	.	.	.	.	.
SOUTHEAST																
FT Gordon, GA	558	498	.	1	.	.	8	3	13	1	.	.	.	1	1	1
FT Benning, GA	230	107	1	.	1	.	4	.	.	1	.	1	.	.	.	.
FT Campbell, KY	176	253	1	.	.	.	.	.	2	.	.	.	.	.	.	.
FT Jackson, SC	157	318	.	.	.	.	.	.	.	.	.	.	1	2	.	.
FT Rucker, AL	47	39	.	7	.	.	2	1	.	.	.	.	.	.	.	.
FT Stewart, GA	397	575	3	.	1	.	7	6	1	10	1	.	7	.	.	.
WESTERN																
FT Lewis, WA	598	858	2	2	.	.	.	4	1	.	.	.	.	.	.	.
FT Irwin, CA	13	82	.	.	.	.	.	1	1	1	.	.	.	.	.	.
FT Wainwright, AK	222	125	3	.	.	.	.	.	.	.	.	.	.	.	.	.
PACIFIC																
Hawaii	424	527	19	16	1	.	7	8	3	1	1	.	4	1	.	.
Japan	30	3	1	.	.	.	.	.	.	.	.	.	.	.	.	.
Korea	347	491	.	.	.	.	.	.	.	.	.	.	.	.	1	.
OTHER LOCATIONS																
Germany	697	967	6	10	2	1	5	5	1	1	1	.	3	1	.	1
Unknown	0	0	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Total	9,899	10,639	46	55	10	9	73	55	39	24	5	3	25	15	13	5

*Events reported by July 8, 2008 and 2009

†Seventy medical events/conditions specified by Tri-Service Reportable Events Guidelines and Case Definitions, May 2004.

Note: Completeness and timeliness of reporting vary by facility.

Sentinel reportable events for service members and beneficiaries at U.S. Army medical facilities, cumulative numbers* for calendar years through 30 June 2008 and 30 June 2009



Reporting locations	Arthropod-borne				Sexually transmitted								Environmental			
	Lyme disease		Malaria		Chlamydia		Gonorrhea		Syphilis [‡]		Urethritis [§]		Cold		Heat	
	2008	2009	2008	2009	2008	2009	2008	2009	2008	2009	2008	2009	2008	2009	2008	2009
NORTH ATLANTIC																
Washington, DC Area	3	10	.	.	63	87	17	10	5	12	.	1	.	.	15	.
Aberdeen, MD	.	.	.	.	1	2	.	1	.	.	.	.	.	.	.	.
FT Belvoir, VA	.	.	.	.	83	90	1	11	.	.	.	.	.	.	.	.
FT Bragg, NC	1	.	4	.	517	740	107	126	1	3	38	16	.	1	44	24
FT Drum, NY	3	.	.	.	143	23	14	3	.	.	.	.	.	.	.	.
FT Eustis, VA	.	.	.	.	112	106	17	16	3	.	.	.	.	.	1	.
FT Knox, KY	1	1	.	.	92	87	17	13	1	.	.	.	.	.	.	.
FT Lee, VA	2	1	1	.	120	228	41	24	.	2	.	.	.	.	3	.
FT Meade, MD	1	.	.	.	29	25	1	.	.	.	.	.	.	.	.	.
West Point, NY	8	6	.	.	15	33	.	2	.	.	.	.	.	.	.	.
GREAT PLAINS																
FT Sam Houston, TX	.	.	.	.	154	255	41	47	12	10	.	.	1	.	2	9
FT Bliss, TX	.	.	.	.	189	188	39	31	4	5	.	.	.	.	.	.
FT Carson, CO	.	.	.	.	333	347	31	37	.	.	12	.	.	1	.	.
FT Hood, TX	.	.	.	.	886	772	157	179	.	4	43	109	.	.	.	.
FT Huachuca, AZ	.	.	.	.	37	42	6	2	.	.	.	.	.	.	2	.
FT Leavenworth, KS	.	2	.	.	21	28	3	3	.	1	.	.	.	.	.	1
FT Leonard Wood, MO	.	.	.	.	92	187	11	19	1	.	.	.	3	1	3	2
FT Polk, LA	.	.	.	.	63	204	20	22	1	1	.	.	.	.	7	53
FT Riley, KS	2	.	1	.	160	214	14	36	.	1	.	1	1	1	.	3
FT Sill, OK	.	.	.	.	47	98	10	14	.	.	.	.	.	.	4	5
SOUTHEAST																
FT Gordon, GA	.	.	.	.	258	318	71	55	.	.	.	.	.	.	.	1
FT Benning, GA	.	.	.	5	143	70	41	19	1	1	.	.	.	.	12	1
FT Campbell, KY	.	4	.	.	79	167	3	44	1	1	.	.	.	.	.	30
FT Jackson, SC	.	.	.	.	118	173	17	26	.	.	.	.	.	.	20	62
FT Rucker, AL	1	.	.	.	32	28	8	2	1	.	.	.	.	.	2	.
FT Stewart, GA	.	.	2	.	290	419	51	77	2	4	.	.	.	.	19	39
WESTERN																
FT Lewis, WA	.	.	.	.	467	535	48	51	1	1	10	5	.	.	.	.
FT Irwin, CA	.	.	.	.	10	60	1	1	.	.	.	.	.	.	1	.
FT Wainwright, AK	1	.	.	.	147	95	19	6	.	.	.	.	12	1	1	.
PACIFIC																
Hawaii	.	.	1	.	303	310	41	36	.	2	.	.	.	.	.	.
Japan	.	.	.	.	16	3	2	.	.	.	.	.	.	.	.	.
Korea	.	.	.	.	296	464	32	22	4	2	.	.	.	1	3	1
OTHER LOCATIONS																
Germany	16	23	7	3	393	599	100	69	4	9	.	.	8	1	4	10
Unknown	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Total	39	47	16	8	5,709	6,997	981	1,004	42	59	103	132	25	7	143	241

‡Primary and secondary.

§Urethritis, non-gonococcal (NGU).

Sentinel reportable events for service members and beneficiaries at U.S. Air Force medical facilities, cumulative numbers* for calendar years through 30 June 2008 and 30 June 2009



Air Force

Reporting locations	Number of reports all events [†]		Food-borne								Vaccine preventable					
			Campylobacter		Giardia		Salmonella		Shigella		Hepatitis A		Hepatitis B		Varicella	
	2008	2009	2008	2009	2008	2009	2008	2009	2008	2009	2008	2009	2008	2009	2008	2009
Air Combat Cmd	1,184	864	3	1	4	5	6	5	3	1	4	.	28	.	4	1
Air Education & Training Cmd	517	980	1	3	3	2	7	11	2	2	3	3	3	3	4	3
Air Force Dist. of Washington	140	182	.	.	.	.	1	1	.	.	.	.	2	2	.	.
Air Force Materiel Cmd	418	327	1	.	1	1	3	2	2	.	1	.	.	4	.	2
Air Force Special Ops Cmd	117	95	.	1	.	.	.	1	.	.	.	.	2	.	.	.
Air Force Space Cmd	223	160	.	1	.	1	4	4	1	.	.	1	2	.	1	2
Air Mobility Cmd	598	468	1	3	2	2	3	3	2	2	.	.	2	3	8	2
Pacific Air Forces	492	424	6	2	5	2	3	2	.	.	3	.	7	4	3	3
U.S. Air Forces in Europe	308	354	1	3	.	1	1	3	.	.	.	.	2	3	1	3
U.S. Air Force Academy	11	39	.	.	.	2	.	1	.	.	.	.	.	.	.	.
Other	361	85	2	1	3	1	6	1	5	.	1	.	.	.	.	1
Total	4,369	3,978	15	15	18	17	34	34	15	5	12	4	48	19	21	17

*Events reported by July 8, 2009

†Seventy medical events/conditions specified by Tri-Service Reportable Events Guidelines and Case Definitions, May 2004.

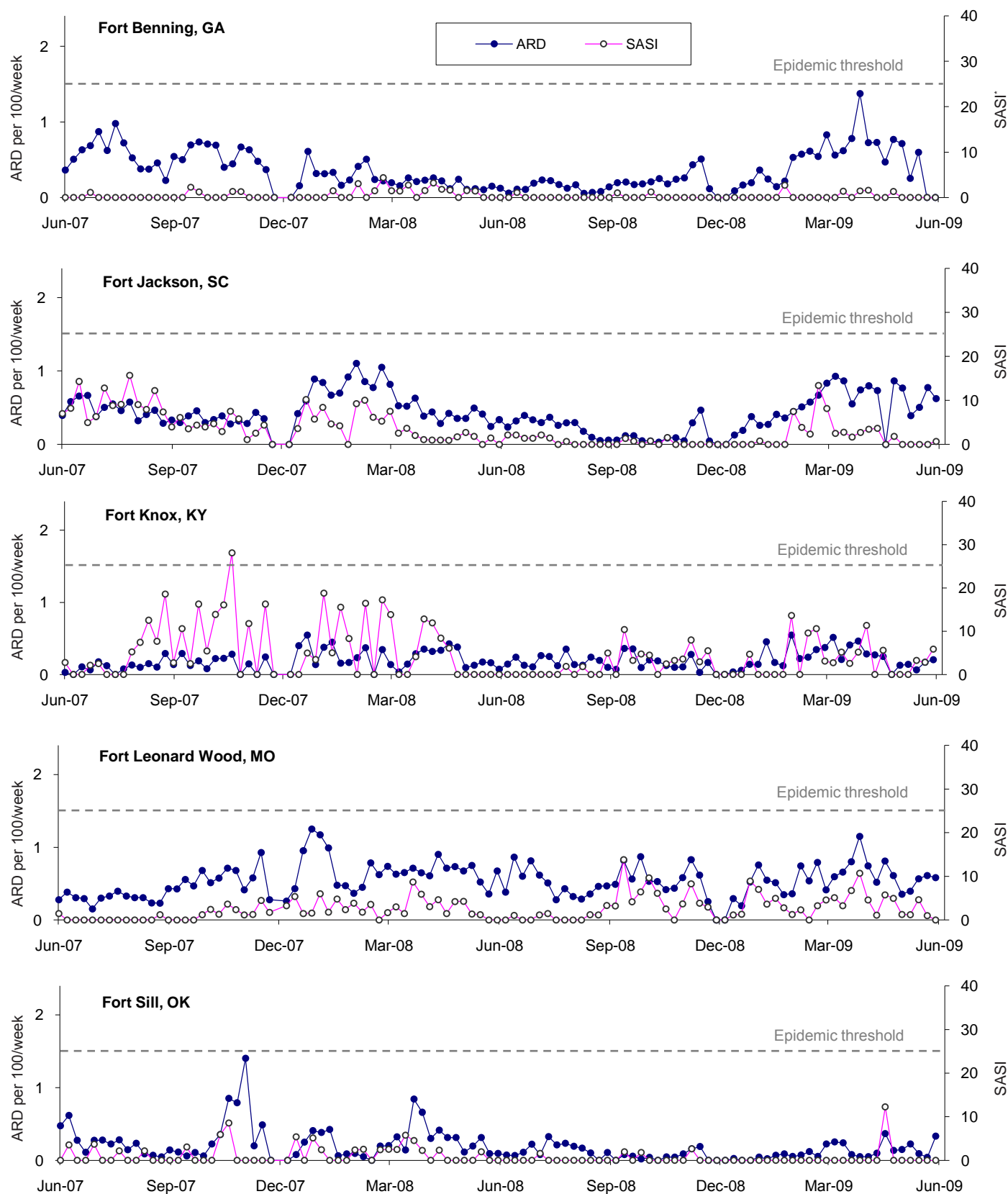
Note: Completeness and timeliness of reporting vary by facility

Reporting locations	Arthropod-borne				Sexually transmitted								Environmental			
	Lyme disease		Malaria		Chlamydia		Gonorrhea		Syphilis [‡]		Urethritis [§]		Cold		Heat	
	2008	2009	2008	2009	2008	2009	2008	2009	2008	2009	2008	2009	2008	2009	2008	2009
Air Combat Cmd	4	5	.	.	662	574	76	46	3	3	1	.	4	4	.	4
Air Education & Training Cmd	2	3	.	.	298	569	28	59	3	3	.	.	.	.	1	2
Air Force Dist. of Washington	2	5	.	.	84	91	12	7	1	.	.	.	.	.	.	.
Air Force Materiel Cmd	6	4	1	.	239	225	29	23	2	1	.	.	.	1	.	.
Air Force Special Ops Cmd	.	1	1	.	98	78	8	2	.	1	.	.	.	1	.	.
Air Force Space Cmd	1	.	.	.	134	118	8	4	.	.	.	.	.	.	.	.
Air Mobility Cmd	8	8	.	.	369	321	38	32	2	1	.	.	2	9	4	.
Pacific Air Forces	.	.	.	.	391	186	22	16	1	2	.	.	.	10	.	1
U.S. Air Forces in Europe	1	2	2	1	246	246	18	18	.	1	.	.	.	2	.	.
U.S. Air Force Academy	1	.	.	.	10	25	.	1	.	.	.	.	.	.	.	.
Other	6	.	.	1	289	20	15	5	1	.	.	.	.	.	.	8
Total	31	28	4	2	2,820	2,453	254	213	13	12	1	0	6	27	5	15

‡Primary and secondary.

§Urethritis, non-gonococcal (NGU).

Acute respiratory disease (ARD) and streptococcal pharyngitis rates (SASI*), basic combat training centers, U.S. Army, by week, June 2007-June 2009



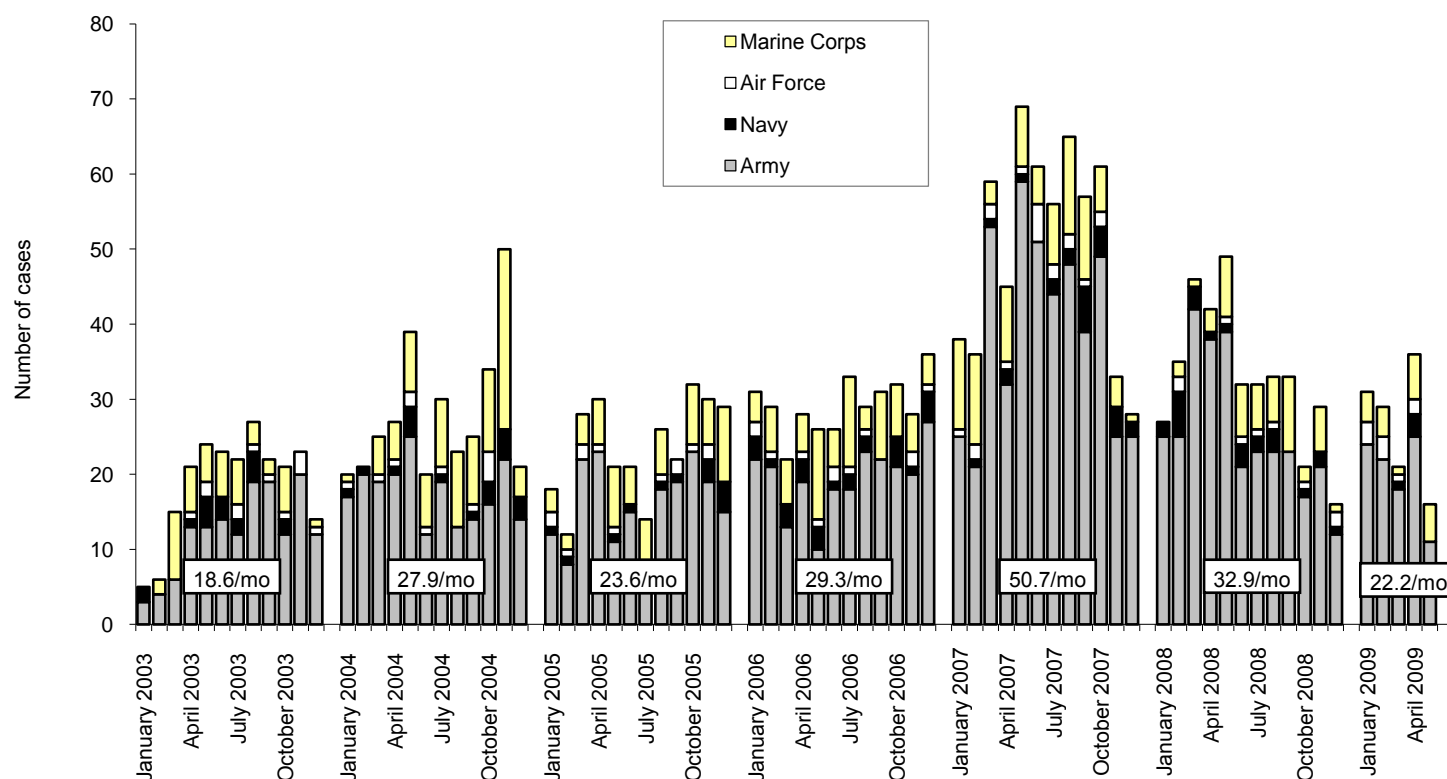
* Streptococcal-ARD surveillance index (SASI) = ARD rate x % positive culture for group A streptococcus

ARD rate = cases per 100 trainees per week

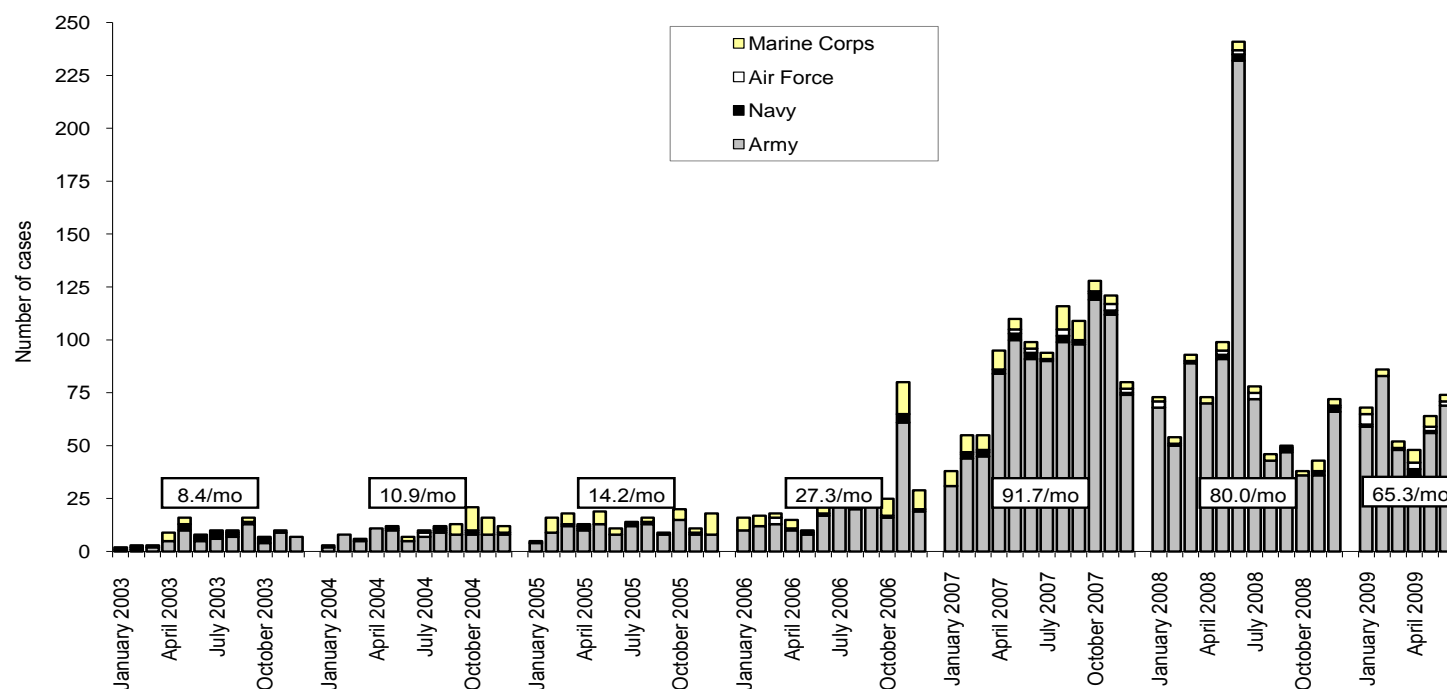
ARD rate ≥ 1.5 or SASI ≥ 25.0 for 2 consecutive weeks are surveillance indicators of epidemics

Deployment-related conditions of special surveillance interest, U.S. Armed Forces, by month and service, January 2003 - June 2009 (data as of 23 June 2009)

Traumatic brain injury, hospitalizations (ICD-9: 310.2, 800-801, 803-804, 850-854, 950.1-950.3, 959.01, V15.5_1-9, V15.5_A-F)*



Traumatic brain injury, multiple ambulatory visits (without hospitalization), (ICD-9: 310.2, 800-801, 803-804, 850-854, 950.1-950.3, 959.01, V15.5_1-9, V15.5_A-F)†



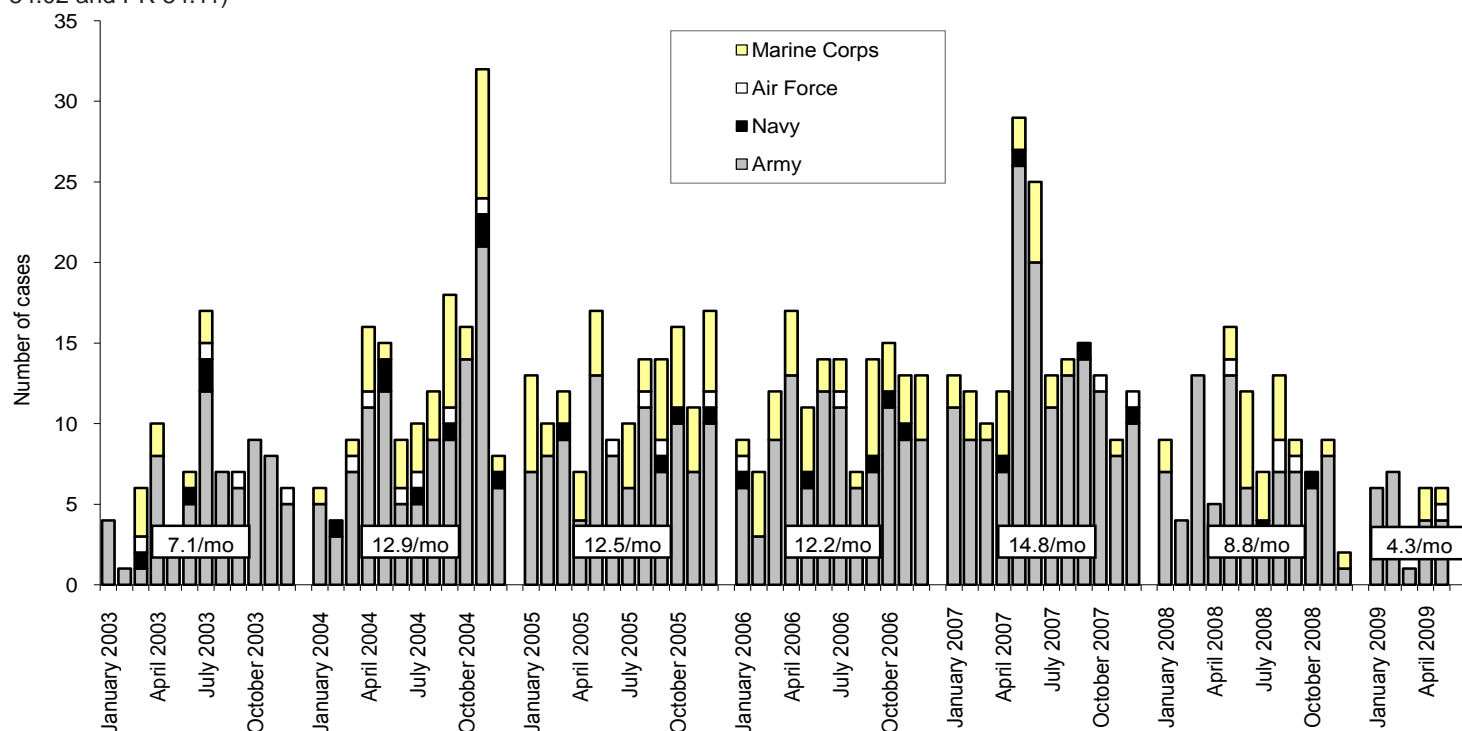
Reference: Armed Forces Health Surveillance Center. Frequencies, rates and trends of use of diagnostic codes indicative of traumatic brain injury (TBI), July 1999-June 2008. MSMR. Dec 2008; 15(10):2-9.

*Indicator diagnosis (one per individual) during a hospitalization while deployed to/within 30 days of returning from OEF/OIF.

†Two or more ambulatory visits at least 7 days apart (one case per individual) while deployed to/within 30 days of returning from OEF/OIF.

Deployment-related conditions of special surveillance interest, U.S. Armed Forces, by month and service, January 2003 - June 2009 (data as of 23 June 2009)

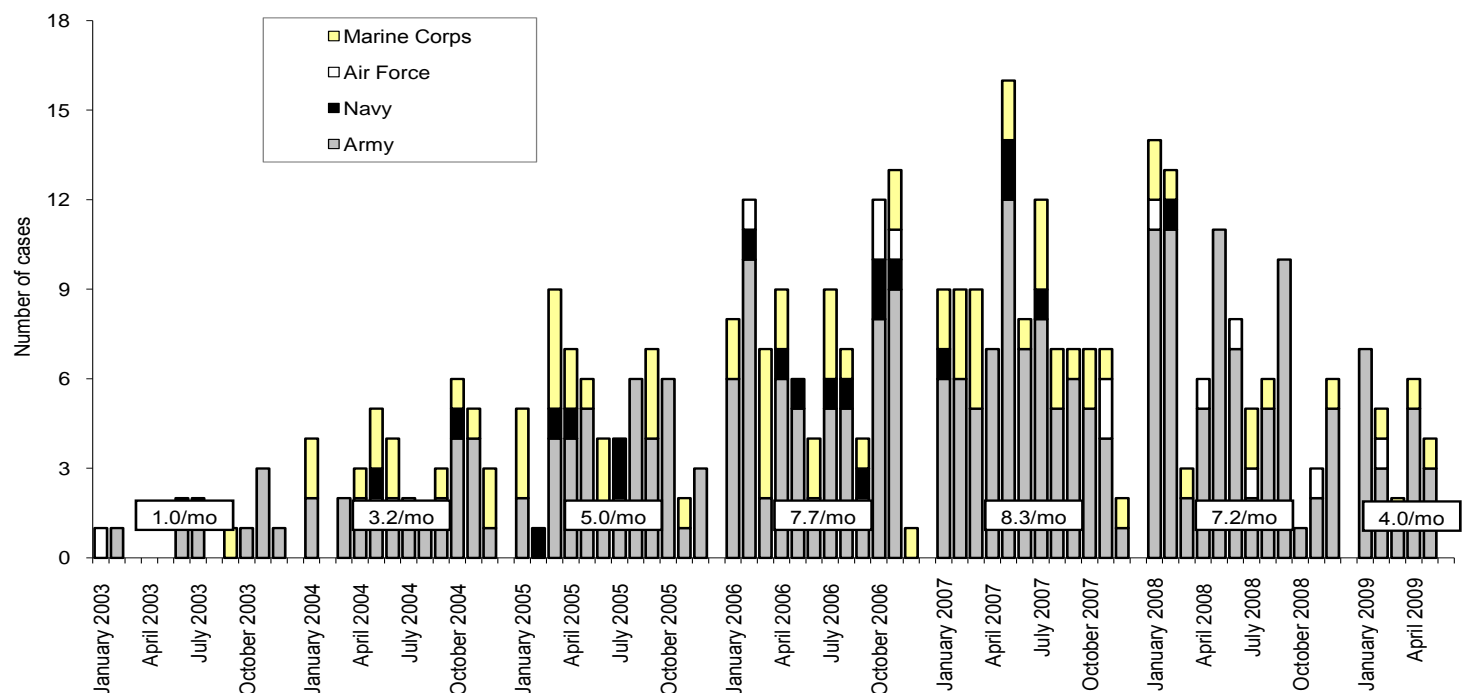
Amputations (ICD-9: 887, 896, 897, V49.6 except V49.61-V49.62, V49.7 except V49.71-V49.72, PR 84.0-PR 84.1, except PR 84.01-PR 84.02 and PR 84.11)*



Reference: Army Medical Surveillance Activity. Deployment-related condition of special surveillance interest: amputations. Amputations of lower and upper extremities, U.S. Armed Forces, 1990-2004. MSMR. Jan 2005;11(1):2-6.

*Indicator diagnosis (one per individual) during a hospitalization while deployed to/within 365 days of returning from OEF/OIF.

Heterotopic ossification (ICD-9: 728.12, 728.13, 728.19)†

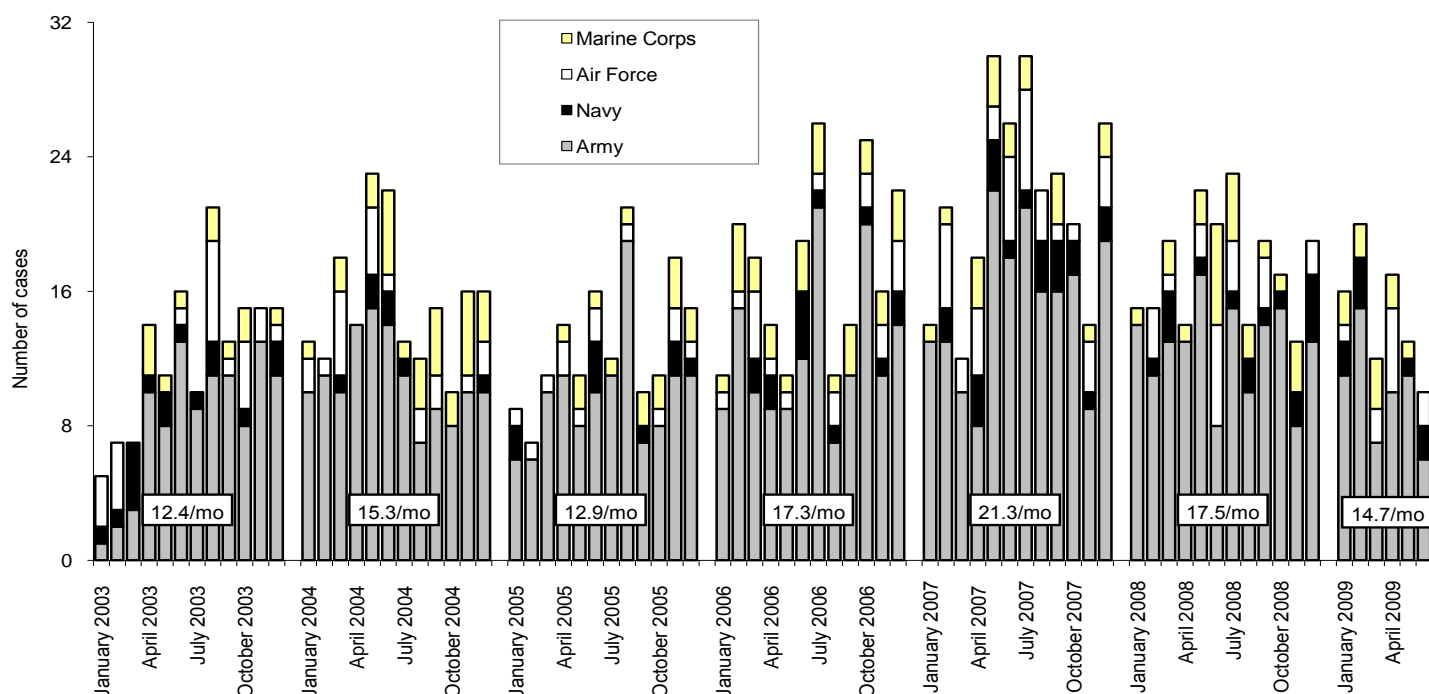


Reference: Army Medical Surveillance Activity. Heterotopic ossification, active components, U.S. Armed Forces, 2002-2007. MSMR. Aug 2007; 14(5):7-9.

†One diagnosis during a hospitalization or two or more ambulatory visits at least 7 days apart (one case per individual) while deployed to/within 365 days of returning from OEF/OIF.

Deployment-related conditions of special surveillance interest, U.S. Armed Forces, by month and service, January 2003 - June 2009 (data as of 23 June 2009)

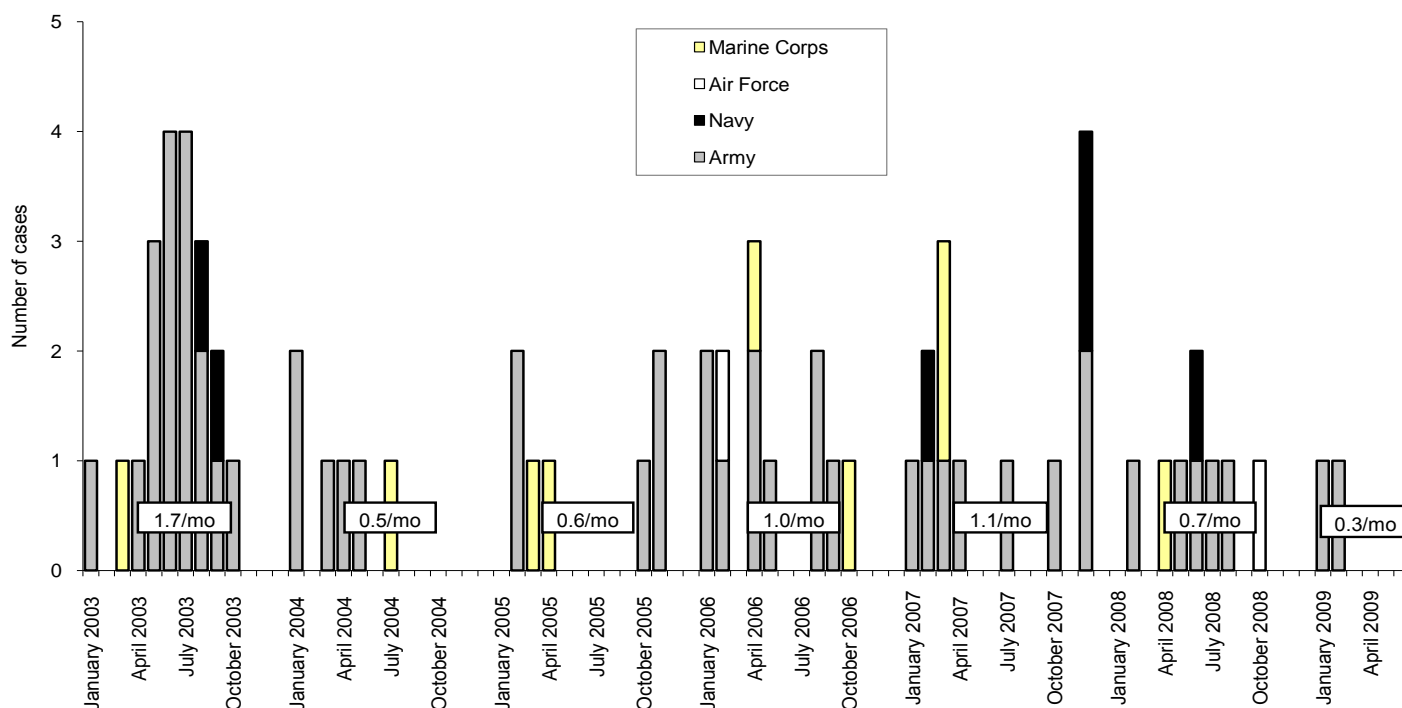
Deep vein thrombophlebitis/pulmonary embolus (ICD-9: 415.1, 451.1, 451.81, 451.83, 451.89, 453.2, 453.40 - 453.42 and 453.8)*



Reference: Isenbarger DW, Atwood JE, Scott PT, et al. Venous thromboembolism among United States soldiers deployed to Southwest Asia. *Thromb Res.* 2006;117(4):379-83.

*One diagnosis during a hospitalization or two or more ambulatory visits at least 7 days apart (one case per individual) while deployed to/within 90 days of returning from OEF/OIF.

Severe acute pneumonia (ICD-9: 518.81, 518.82, 480-487, 786.09)†

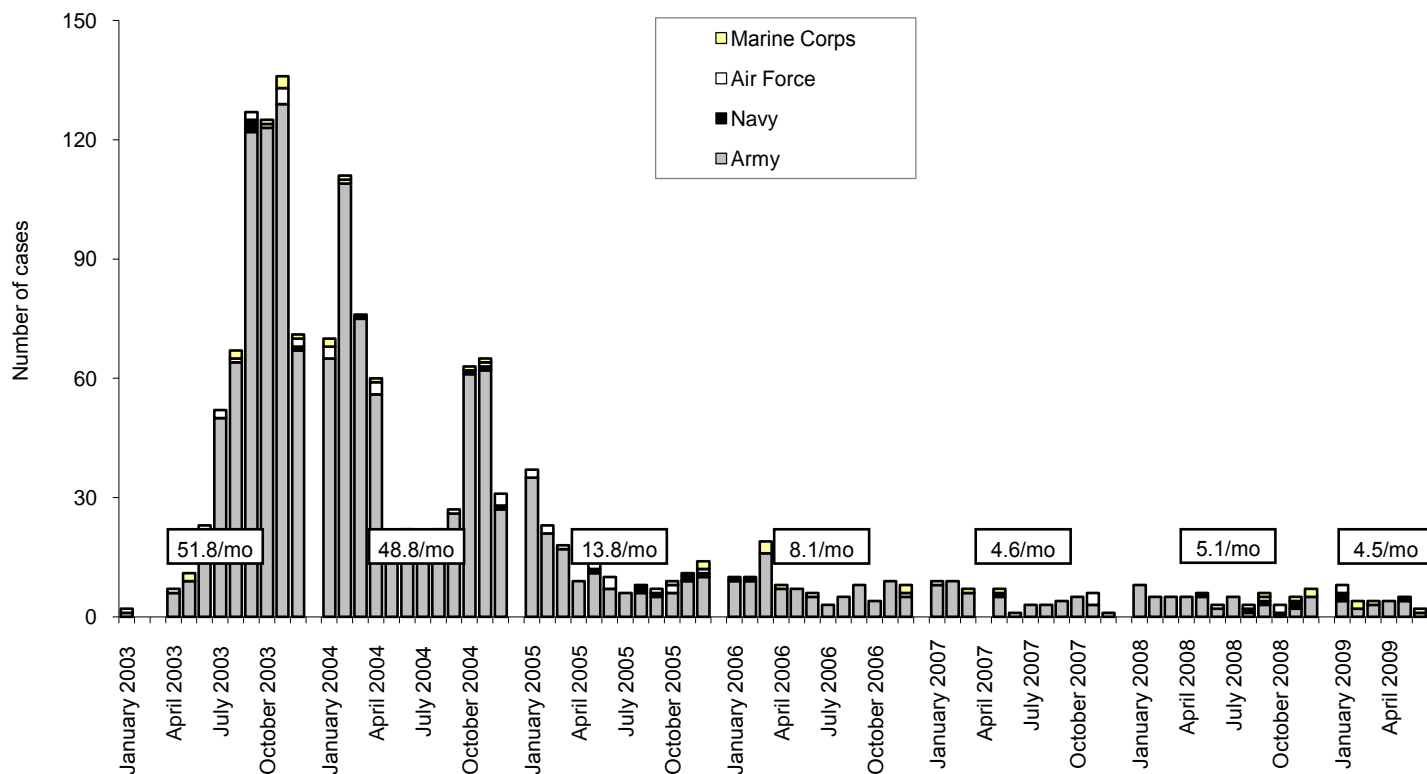


Reference: Army Medical Surveillance Activity. Deployment-related condition of special surveillance interest: severe acute pneumonia. Hospitalizations for acute respiratory failure (ARF)/acute respiratory distress syndrome (ARDS) among participants in Operation Enduring Freedom/Operation Iraqi Freedom, active components, U.S. Armed Forces, January 2003-November 2004. *MSMR.* Nov/Dec 2004;10(6):6-7.

†Indicator diagnosis (one per individual) during a hospitalization while deployed to/within 30 days of returning from OEF/OIF.

Deployment-related conditions of special surveillance interest, U.S. Armed Forces, by month and service, January 2003 - June 2009 (data as of 23 June 2009)

Leishmaniasis (ICD-9: 085.0 to 085.9)*



Reference: Army Medical Surveillance Activity. Deployment-related condition of special surveillance interest: leishmaniasis. Leishmaniasis among U.S. Armed Forces, January 2003-November 2004. MSMR. Nov/Dec 2004;10(6):2-4.

*Indicator diagnosis (one per individual) during a hospitalization, ambulatory visit, and/or from a notifiable medical event during/after service in OEF/OIF.

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